

OCCURRENCE OF SPERMATOPHORES IN CERTAIN SPECIES OF CHILOCORUS

(Coleoptera: Coccinellidae)

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During the past ten years several species of diaspine-scale-feeding coccinellid beetles have been under propagation at the Citrus Experiment Station, Riverside, California, the host being mainly latania scale, *Hemiberlesia lataniae* (Signoret), on potato tubers. In the routine inspections for eggs and small larvae among the host scales, some peculiar, rather pyriform pellets were encountered in the cultures of *Chilocorus* spp.¹

A culture of *Chilocorus cacti* (Linnaeus) was started in the fall of 1954 from a small colony taken from mesquite in southeastern Arizona. During a study of the larval characteristics of this species, numbers of the peculiar pellets were observed in the debris of the culture cage.



EXPLANATION OF FIGURE

Fig. 1. Left to right, fecal castings, eggs, and spermatophores of *Chilocorus discoideus* Crotch, an African species that produces a larger spermatophore than does *C. cacti*. Scale is in millimeters.

Observations on the origin of the pellets showed that (1) unmated females produced no viable eggs and no pellets; (2) a group of mated females produced viable eggs and fewer pellets

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than there were females; (3) a group of unmated females placed and held with males eventually produced viable eggs and more pellets than there were females; (4) males alone produced no pellets. These observations were facilitated by the obvious sexual dimorphism in the adults of *C. cacti*. A correlation between mating and pellet formation was thus indicated and suggested the possibility of the pellets being spermatophores. A survey of the literature revealed no mention of spermatophores as occurring in the Coccinellidae. Cros (1924) and Khalifa (1949) reported spermatophores in the Coleoptera only in the families Cantharidae, Chrysomelidae, Curculionidae, Dytiscidae, Meloidae, and Scarabaeidae. The present study shows that the family Coccinellidae, as represented by eight species of *Chilocorus*, belongs in this list. Spermatophores were found in *Chilocorus cacti*, *C. discoideus* Crotch, *C. distigma* Klug, *C. fraternus* LeConte, *C. kuwanae* Silvestri, *C. orbis* Casey, *C. stigma* Say, and a new species from Kenya.

Attempts to determine the source and function of the pellets were made along two lines: (1) the chemical and/or physical nature of the pellets, and (2) their functional role. *Chilocorus discoideus* only was used in this study (fig. 1).

Physical properties: The voided pellets are roughly pyriform, 0.8×1.5 mm. in size, pearl white or yellow to brown in color, and are hollow with a small orifice at the narrow end. The wide end is closed. Under 3600 Angstrom units of ultra-violet light the pellets fluoresce brightly both from their outer and inner surfaces.

Chemical properties: The Van Wisselingh test for chitin gave a negative response. When held in distilled water, glacial acetic acid, and 10% KOH, the pellets become soft and rather amorphous. These solvents also become fluorescent. Ethyl alcohol (95%) seemingly does not change their appearance nor does it become fluorescent. A preliminary biochemical analysis showed indications of fat, protein, and carbohydrates.

Functional role: The relationship of the pellets to mating has already been mentioned. Observation of pairs of *Chilocorus discoideus* revealed that they remained in copula for 40 to 105 minutes. The females voided the pellets as hollow bodies 18 to 24 hours later. From a group of both sexes which contained 30 females, the number of cast-off pellets indicated that each female mated an average of 32 times during a four-month period. Gross

dissections at intervals during copulation subsequently resolved the probable source and function of these pellets.

The female of a pair was dissected 30 minutes after copulation began. The bursa was then seen to be filled with a semifluid undifferentiated mass which contained no sperm. There were no sperm in the spermatheca. Another copulating female was examined after 40 minutes and sperm were seen near the inner tip of the mass, which now was definitely known to be a spermatophore. At this time some sperm had already moved into the spermatheca. Several females were dissected immediately following copulation. Each time the bursa was filled with a spongy mass, sperm were in the spermatheca as well as still swimming up the five mm. long sperm duct, and some were at the entrance of the sperm duct which is located (dorsally) at the extreme anterior end of the bursa.

Three hours after copulation the bursa is distended by the spermatophore. By this time the spermatophore is distinctly composed of an outer layer which fluoresces and an internal gelatine-like mass which does not fluoresce. Its general appearance is clearly that of the voided pellet. After 20 hours the *in situ* spermatophore is compressible and leathery in consistency. The voided spermatophore becomes hard within 30 minutes. Attempts were made to kill pairs *in copula* in order to establish the exact role of the male genitalia in sperm transfer and spermatophore formation. The technique used, however, did not accomplish the desired result. A study comparable to that of Blunck (1912), wherein serial sections of pairs of *Dytiscus marginalis* LeConte were made at intervals during copulation and the actual transfer of sperm and the construction of the spermatophore could easily be followed, is desirable.

Dissections of sexually mature males revealed that the accessory glands fluoresced brightly. It is of interest that in the body of the male each sperm travels about 34 mm. The testes and sperm from the spermatheca did not fluoresce nor did any organ or gland within the female.

It is apparent from the foregoing observations that the principal source of the spermatophore in *Chilocorus* is the accessory gland of the male. During copulation the glandular secretions enter the bursa of the female, expand, and consequently assume the general shape of the bursa. An outer layer becomes differen-

tiated as a semisolid and is referred to as the wall of the spermatophore. The exact nature of the nonfluorescent inner mass is not understood. It may be material previously secreted by the female and subsequently enveloped by the male's secretions during formation of the spermatophore. At any rate, it is believed that the sperm and associated fluids are ejected into the interior of the forming spermatophore.

Although the primary function, by definition, of the spermatophore is the transfer of sperm, it is thought that in *Chilocorus* other functions of importance are also performed. The swollen spermatophore and the attendant distension of the bursa could serve to prevent loss of sperm through migration away from the opening of the sperm duct.

Since the voided spermatophore has a definite pore at the anterior end, and since the pore is not apparent in the spermatophore *in situ*, it seems logical that the pore is formed by the sperm and associated fluids being forced through by the pressure of the swelling spermatophore upon its contents. The fact that the spermatophore when voided is empty (as is the bursa) suggests that the female either absorbs or voids its contents. The latter would be possible only after the spermatophore was passed.

Another possible function of the spermatophore is the preparation of the vaginal opening for oviposition. The passage of the spermatophore, by distending the opening, would allow the relatively free passage of the bulky eggs which follow.

The commonly observed low per cent of viable eggs deposited by *Chilocorus*, correlated with the need for repeated matings, is a probable result of a relatively inefficient fertilization mechanism.

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